Energy Smart Services

solutions & incentives for business

SECTION 2C

STANDARD INCENTIVES FOR HVAC & MOTORS

- When making a large capital investment in an energy intensive piece of equipment, it's worth taking a close look at long term operating costs. This section provides a streamlined method for determining the benefits of higher efficiency in commonly installed **HVAC** equipment. By entering data for high performance equipment into the applicable Funding Calculation Worksheets, energy savings and incentive amounts can be determined quickly and easily. These can then be weighed against known equipment costs to make the most informed equipment selection.
- Besides yielding energy and bill savings, HVAC investments have the potential to improve occupant comfort, improve indoor air quality, and reduce occupant complaints.
- **Motors** are the invisible "drivers" of many building and industrial functions. Selection of new premium efficiency motors- supported by Energy Smart Services Financial Incentives - is usually a wiser choice than rewinding old motors.

from Seattle City Light

Section 2C.
Standard Incentives
for HVAC and Motors

- Instructions for Filling Out the Funding Calculation Worksheets for HVAC and Motors
- Funding Calculation Worksheets for HVAC and Motors
- Standard Specifications
  for Chillers, Heat Pumps, Air Conditioners, and Motors
- Standard Specifications
  for Variable Speed Drives and Inverter Duty Motors

Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors

ELIGIBILITY

The following equipment is eligible for funding:

- Chillers
- Air Conditioners
- Heat Pumps
- Variable Speed Drives (VSDs) retrofitted on HVAC variable air volume fans
- National Electrical Manufacturers Association (NEMA) Premium Efficiency Motors

Back-up equipment is not eligible for funding unless the back-up and lead (non-back-up) equipment is switched on a regular basis. If the back-up and lead equipment are switched on a regular basis, the backup equipment and the lead equipment are each eligible for funding using half the annual kWh savings estimated for year-round use of either one.

GENERAL INSTRUCTIONS

1. Use of Spreadsheet Software

HVAC Standard Incentives are quickly calculated using the *Funding Calculation Worksheets.* The electronic file containing these worksheets can either be downloaded from the web at www.EnergySmartServices.com, or obtained upon request from Seattle City Light by calling (206) 684-3254. The worksheets should be filled out electronically rather than by hand.

2. Project Costs

The customer or trade ally should either enter the material cost (equipment and WSST) or the incremental cost (the difference between two bids, one for equipment that just meets code and one for the proposed equipment). Then the "Cost Type" is entered: "M" for material cost, or "I" for incremental cost.

3. Final Determination of Funding Level

The Energy Management Analyst will review the worksheet(s) and reserves the right to adjust the amount of funding as a result of this review. Funding amounts are only finalized in the Seattle City Light contract, and funding is only available if a contract is issued before equipment is purchased.

4. Multiple Funding Sources

If a project will receive conservation funding from multiple utilities, Seattle City Light caps the Energy Smart Services incentive amount so that the sum of all utility funding does not exceed 70% of the total Energy Conservation Measure cost.

CHILLERS, AIR CONDITIONERS AND HEAT PUMPS

1. Baseline

The baseline for chillers, air conditioners and heat pumps is the Energy Code for projects in existing facilities as well as projects in new construction, except when a heat pump replaces electric resistance heat in an existing facility. Energy Code baseline efficiencies are automatically provided in the *Funding Calculation Worksheets.*

2. Energy Codes

The baseline efficiency for equipment installed in the City of Seattle is taken from the Seattle Energy Code, which is the same as the Washington State Code concerning efficiencies for heat pumps and air conditioners. Two worksheets are provided for chillers, one for projects in Seattle, and the other for projects that fall under the Washington State Code.

3. Efficiency Ratings

The funding calculations are based on formal industry **standard seasonal** efficiency ratings required by the Energy Code and developed by the American Refrigeration Institute (ARI), a manufacturers' association. Full-load efficiency ratings, and efficiency ratings at conditions specific to a project, are not accepted. For example, NPLV efficiency ratings are not accepted for chiller and air conditioner funding calculations. The complexity and variety of standard efficiencies (e.g. SEER, HSPF, IPLV, COP) and equipment categories is necessary for compatibility with industry standards and the Energy Codes. The worksheets automatically convert the multiple types of efficiency ratings to a common set of units.

4. Hours of Operation

“Equivalent full load hours” are equal to the hours of operation multiplied by the average load factor. These have been standardized in the Seattle City Light calculations, taking into account computer analyses of prototype buildings, and surveys of facility operators to evaluate the typical run times and loading levels on various types of equipment.

5. Multiple Identical Units

A single *Funding Calculation Worksheet* may be used for multiple units with the same model number. For multiple units with different model numbers, use a separate worksheet for each model number.

6. Small Air Conditioners and Air-to-air Heat Pumps

Air to air heat pumps are covered under both the *Air to Air Heat Pump* worksheet, and the *PTAC and PTHP* worksheet. Small air conditioners are covered under both the *Air Conditioner* worksheet and the *PTAC and PTHP* worksheet. The ARI standards determine which equipment falls under which category. The efficiency rating given in the manufacturer's literature will probably make the appropriate category clear.

7. Air-to-air Heat Pumps

The *"Air-to-air Heat Pump" Worksheet* contents change automatically depending on whether the baseline is electric heat and whether or not the baseline has air conditioning. Before printing out the form for a hard copy, make sure the yes/no responses to the questions about the baseline have been filled in.

VARIABLE SPEED DRIVES

1. Scope

The Standard Incentive calculation for VSDs applies only to variable speed drives retrofitted onto existing variable air volume HVAC air distribution systems. For other VSD applications, a Custom Incentive calculation is used.

2. Purchase of Inverter Duty Motors

If the customer or contractor decides that a new motor would be necessary for reliable operation under VSD operation, an inverter duty motor may be purchased and included in the cost of the VSD Energy Conservation Measure. The inclusion of the motor doesn't change the energy savings attributed to the measure, but may increase the funding level if the measure is limited by the Cost Cap.

MOTORS

1. Eligibility

For all constant-speed motor applications, motors with a NEMA Premium Efficiency rating are eligible for funding using the *Funding Calculation Worksheet for NEMA Premium Efficiency Motors*. Motors serving back-up equipment are not eligible for funding unless the back-up and lead (non-back-up) equipment is switched on a regular basis. If the back-up and lead equipment are switched on a regular basis, the backup equipment and the lead motors are each eligible for funding using half the annual kWh savings estimated for year-round use of either one.

If a motor is served by a variable speed drive (VSD), it is not eligible for Energy Smart Services funding as a high efficiency or premium efficiency motor. A new inverter-duty motor purchased for reliable system performance with a variable speed drive is included as part of the VSD funding calculation. It is not included as an additional energy savings but as part of the total VSD measure cost. See section on VSD funding.

2. Definitions

The minimum efficiencies required of the NEMA Premium Motors can be found on the NEMA Web site, or in the *Motor Reference Table* located at the end of the HVAC and motor *Funding Calculation Worksheets.*

3. Energy Savings and Funding Level Calculations

If the Energy Code is used as the baseline, motors are funded using a quick and easy Standard Incentive for Motors. Under special circumstances, an existing motor, not the Energy Code, may be used as baseline, in which case funding is issued as a Custom Incentive.

Energy Code as Baseline— Standard Incentive

When the Energy Code is baseline, use the *Funding Calculation Worksheet for NEMA Premium Efficiency Motors*. The Energy Code must be used as baseline for motors if any of the following is true:

- The project is new construction or a major remodel
- The motor is to go into an existing facility, but is not replacing an existing motor
- The new motor is larger (Hp) than the motor it is replacing
- The new motor is replacing a motor that is broken or no longer in use
- The motor is under 75 Hp

If any of the above conditions apply, and if the motor is not covered by the Seattle or Washington State Energy Code, the EPACT efficiency levels must be used as baseline. At the time of this printing, the Seattle and Washington State Energy Codes and EPACT minimum motor efficiencies are the same, so the *Funding Calculation Worksheet for NEMA Premium Efficiency Motors* has broad application.

For convenience, motor purchases that do **not** meet any of the above conditions may also be funded using the Energy Code as the baseline.

Existing Motor as Baseline—Custom Incentive

Downsizing Oversized Motors. If a motor doesn't fall under one of the categories for which use of the energy code is required as baseline, and if the existing motor is less than 50% loaded, the existing motor may be used as baseline for downsizing. Use a Custom Incentive calculation.

Replacing Large Standard Efficiency Motors. If a motor doesn't fall under one of the categories for which use of the energy code is required as baseline, and if a motor is standard, not "energy efficient", the existing motor nameplate efficiency may be used as the basis of a Custom Incentive. For motors 100 Hp and greater, the actual load factor must be measured to avoid overestimating the savings. For motors less than 100 Hp, the savings should be calculated assuming either a 70% load factor, or using a measured load factor.

RELATED DOCUMENTS

Section 2—*Financial Incentives for ECM Installation–Steps to Participate*.

Section 2—*Standard Specifications for All ECM Installation Incentives*. These specifications are attached to the Energy Smart Services contracts as requirements that must be met prior to Seattle City Light payment.

Seattle City Light Energy Smart Services

Funding Calculation Worksheets for HVAC and Motors

- Funding Calculation Worksheet for Chillers in Seattle
- Funding Calculation Worksheet for Chillers outside Seattle
- Funding Calculation Worksheet for Air Conditioners
- Funding Calculation Worksheet for Air-to-Air Heat Pumps
- Funding Calculation Worksheet for Hydronic Heat Pumps
- Funding Calculation Worksheet for Packaged Terminal Air Conditioners (PTAC), and Packaged Terminal Heat Pumps (PTHP)
- Funding Calculation Worksheet for Variable Speed Drives for HVAC VAV Systems
- Funding Calculation Worksheet for NEMA Premium Efficiency Motors

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for CHILLERS to be Installed in Seattle

In section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors.*

Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.

Multiple identical chillers may be covered on a single sheet.

Facility Name | Form Completed by | Date

Manufacturer / Model Number | Chiller on-site identifier, such as CH-1

I. BASELINE EFFICIENCY RATING From the 2002 Seattle Energy Code, Table 14-1C

Equipment Type	Rated Cooling Capacity (tons)	Check One	Efficiency	
			IPLV (Btuh / Btuh)	**Equivalent kW / ton**
Air Cooled - With Condenser	all capacities		3.05	**1.15**
Air Cooled - Condenserless	all capacities		3.45	**1.02**
Water Cooled	less than 40 tons		5.05	**0.70**
	from 40 up to but not including 150 tons		5.25	**0.67**
	from 150 up to but not including 300 tons		5.90	**0.60**
	300 tons and greater		6.40	**0.55**
Is the chiller centrifugal, water-cooled, and **NOT** exposed on the roof? Enter **Y** for Yes or **N** for No.				

II. ANNUAL ENERGY SAVINGS

A	Baseline IPLV in kW / ton	From table above		kW / ton
B	Proposed IPLV in kW / ton[1]	If the manufacturer gives the IPLV in kW / ton, enter it here, and do not fill out line C.		kW / ton
C	Proposed IPLV in Btuh / Watt[1]	If the manufacturer gives the IPLV in Btuh / Watt, enter it here. Do not fill out line B		Converted kW / ton
D	Efficiency Improvement	(line A) - (line B), or (line A) - (line C)		kW / ton
E	Equivalent Full Load Hours[2]	Use 1,100 if air handler(s) served by this chiller have 100% OSA economizer, otherwise use 1,600		hrs / yr
F	Cooling capacity / Chiller	Rated at ARI Standard Rating Conditions		tons
G	Energy Savings per Chiller	(line D) x (line E) x (line F)		kWh / yr
H	Number of Chillers	Use one sheet per type of chiller		
I	Total Cooling Capacity	(line F) x (line H)		tons
J	Total Energy Savings	(line G) x (line H)		kWh / yr

III. COST & FUNDING

K	Chiller Cost	Enter either the material cost or the incremental cost.	
L	Type of cost entered on row K	Material or Incremental cost (enter M, or I)	
M	Cost Cap	50% of Material Cost, or 100% of Incremental Cost	
N	Value of Savings to SCL	For water-cooled centrifugal chillers not exposed on roof, (line J) x $0.29 / kWh, for all other chillers, (line J) x $0.23 / kWh	

Seattle City Light Use Only

Approved Funding Amount[3]	Approved by (initial):		Date	

Footnotes:

1) Proposed efficiency rating shall be based on ARI 550/590.
2) Equivalent full load hours are the hours per year the equipment is on, multiplied by the average load factor.
3) This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between the customer and Seattle City Light.

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for CHILLERS to be Installed Outside Seattle

In section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors.*
Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.
Multiple identical chillers may be covered on a single sheet.

Facility Name | Form completed by | Date

Manufacturer / Model Number | Chiller on-site identifier, such as CH-1

I. BASELINE EFFICIENCY RATINGS from the 2006 WA State Energy Code, Table 14-1C

Equipment Type	Rated Cooling Capacity (tons)	Check One	Efficiency	
			IPLV (Btuh / Btuh)	**Equivalent kW / ton**
Reciprocating	all capacities		5.05	**0.70**
Screw and Scroll	less than 150 tons		5.20	**0.68**
	from 150 up to but not including 300 tons		5.60	**0.63**
	300 tons and greater		6.15	**0.57**
Centrifugal	less than 150 tons		5.25	**0.67**
	from 150 up to but not including 300 tons		5.90	**0.60**
	300 tons and greater		6.40	**0.55**
Is the centrifugal chiller water-cooled and **NOT** on the roof? Enter **Y** for Yes or **N** for No.				

II. ANNUAL ENERGY SAVINGS

A	Baseline IPLV in kW / ton	From table above		kW / ton
B	Proposed IPLV in kW / ton[1]	If the manufacturer gives the IPLV in kW / ton, enter it here and do not fill out line C.		kW / ton
C	Proposed IPLV in Btuh / Watt[1]	If the manufacturer gives the IPLV in Btuh / Watt, enter it here. Do not fill out line B		Converted kW / ton
D	Efficiency Improvement	(line A) - (line B), or (line A) - (line C)		kW / ton
E	Equivalent Full Load Hours[2]	Use 1,100 if air handler(s) served by this chiller have 100% OSA economizer, otherwise use 1,600		hrs / yr
F	Cooling capacity / Chiller	Rated at ARI Standard Rating Conditions		tons
G	Energy Savings per Chiller	(line D) x (line E) x (line F)		kWh / yr
H	Number of Chillers	One form per type of chiller		
I	Total Cooling Capacity	(line F) x (line H)		tons
J	Total Energy Savings	(line G) x (line H)		kWh / yr

III. COST & FUNDING

K	Chiller Cost	Enter either the material cost or the incremental cost.	
L	Type of Cost entered on row K	Material or Incremental cost (enter M, or I)	
M	Cost Cap	50% of Material Cost, or 100% of Incremental Cost	
N	Value of Savings to SCL	For water-cooled centrifugal chillers not exposed on roof, (line J) x $0.29 / kWh, for all other chillers, (line J) x $0.23 / kWh	

Seattle City Light Use Only

Approved Funding Amount:[3]	Approved by (initial):	Date:

Footnotes:

1) Proposed efficiency rating shall be based on ARI 550/590.
2) Equivalent full load hours are the hours per year the equipment is on, multiplied by the average load factor.
3) This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between the customer and Seattle City Light.

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for AIR CONDITIONERS

In Section 2C of the Program Manual, see the *Instructions Filling out the Funding Calculation Worksheets for HVAC and Motors*.
Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.
Multiple identical air conditioners may be covered on a single sheet.

Facility Name	Form completed by	Date

Manufacturer / Model Number

Air Handling Unit on-site ID(s), such as AHU-3

I. BASELINE EFFICIENCY RATINGS - From the Seattle Energy Code, Table 14-1A

Equipment	Rated Cooling Capacity (Btuh)	Check One	Efficiency (Btuh / Watt)	
Air-Cooled - Split Systems	less than 65,000		10.00	SEER
Air Cooled - Single Package	less than 65,000		9.70	SEER
Air Cooled	from 65,000 up to but not including 135,000		10.30	EER
	from 135,000 up to but not including 240,000		9.70	EER
	from 240,000 up to but not including 760,000		9.70	IPLV
	760,000 and greater		9.40	IPLV
Water or Evaporatively Cooled	less than 65,000		12.10	EER
	from 65,000 up to but not including 135,000		11.50	EER
	from 135,000 up to 240,000		11.00	EER
	greater than 240,000		10.30	IPLV

II. ANNUAL ENERGY SAVINGS AND FUNDING

A	Baseline Efficiency	from table above		Btuh / Watt
B	Proposed Efficiency[1]	from manufacturer's literature[1]		Btuh / Watt
C	Efficiency Improvement	(1 / line A) - (1 / line B)		Watt / Btuh
D	Equivalent Full Load Hours[2]	Use 1,100 if there is 100% outside air capability, otherwise use 1,600		hrs / yr
E	Cooling Capacity in Btu / hr per Unit	Rated at ARI Standard Rating Conditions		Btuh
F	Estimated Energy Savings per Unit	[(line C) x (line D) x (line E)] / 1000		kWh / yr
G	Number of Air Conditioners	Use one sheet per type of air conditioner.		
L	Total Cooling Capacity	[(line E) x (line G)] / 12,000		tons
H	Total Energy Savings	(line F) x (line G)		kWh / yr

III. COST & FUNDING

I	Air Conditioner Cost	Enter the material cost or the incremental cost.	
J	Type of Cost entered on row I	Material, or Incremental Cost (enter M, or I)	
K	Cost Cap	50% of Material Cost, or 100% of Incremental Cost	
L	Value of Savings to SCL	(line H) x $0.20 / kWh	

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Approved Funding Amount[3]	Approved by (initial):		Date:	

Footnotes:

1) Performance rating to include compressor, condenser, and air distribution fans. The proposed efficiency rating must be based on ARI 210/240 (for under 135,000 Btuh capacity) or ARI 340/360 (for 135,000 Btuh or above).
2) Equivalent full load hours are the hours per year the equipment is operating multiplied by the average load factor.
3) This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between the customer and Seattle City Light.

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for AIR-TO-AIR HEAT PUMPS

In Section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors.*
Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.
Multiple identical heat pumps may be covered on a single sheet.

Facility Name | Form Completed by | Manufacturer & Model Number | Date

I. BASELINE DESCRIPTION

IMPORTANT: The contents of this form change automatically based on responses to the following questions. For this reason, a hard-copy printout is only relevant for the specific baseline conditions selected below.

- For new construction: No baseline description is required; the baseline automatically becomes the Energy Code.
- For an existing facility: **Will the proposed heat pump replace electric resistance heat?** Enter Y for Yes, N for No……..
- For an existing facility: **Does the area to be served by the proposed heat pump already have air conditioning?** (Y/N) ……

II. BASELINE AND PROPOSED EFFICIENCY RATINGS

Fill out the row which corresponds to the type and cooling capacity of your heat pump unit(s), then continue with Section III.		Check One	Baseline[1]				Proposed[2] (from manufacturer's literature)			
			Cooling		Heating		Cooling		Heating	
Type	Rated Cooling Capacity (Btu / hr)		col. a		col. b		col. c		col. d	
Split System	less than 65,000		10.0	SEER	6.8	HSPF		SEER		HSPF
Single Package	less than 65,000		9.7	SEER	6.6	HSPF		SEER		HSPF
Split System or Single Package[3]	65,000 up to 134,999		10.1	EER	3.2	COP		EER		COP
	135,000 up to 239,999		9.3	EER	3.1	COP		EER		COP[1]
	240,000 and greater		9.2	IPLV	3.1	COP		IPLV		COP[1]

III. ENERGY SAVINGS, COST & FUNDING

A	Cooling efficiency improvement[1]	col. a - col. C, converted to watt/Btuh		Watt / Btuh	Cooling
B	Cooling capacity	from manufacturer's literature		Btuh	
C	Cooling equivalent full load hours[4]	--------	700	hrs / yr	
D	Cooling energy savings per heat pump	(line A x line B x line C) / 1,000		kWh / yr	
E	Heating efficiency improvement	col. b - col. D, converted to watt/Btuh		Watt / Btuh	Htg
F	Heating equivalent full load hours[4]	--------	1,000	hrs / yr	
G	Heating energy savings per heat pump	(line E x line B x line F) / 1,000		kWh / yr	
H	Total energy savings per heat pump	line D + line G		kWh / yr	Total
I	Number of identical heat pumps	Use one sheet per type of heat pump			
J	Total cooling capacity	(line B x line I) / 12,000		Tons	
K	Total energy savings	line H x line I		kWh / yr	
L	Heat Pump Cost	Enter the material cost or the incremental cost.			Cost & Funding Caps
M	Type of Cost entered on row L	Material or Incremental cost (enter M, or I)			
N	Cost Cap	50% of Material Cost, or 100% of Incremental Cost			
O	Value of Savings to SCL	line K x $ 0.20 / kWh)			

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Approved Funding Amount[5]	Approved by (initial):	Date:

Footnotes:

1) If the proposed heat pump is replacing electric resistance heat, the baseline heating efficiency is automatically set to 1. If the heat pump is replacing electric resistance heat, and the space currently has no air conditioning, the new heat pump's annual cooling energy is automatically calculated and subtracted from the heat pump kWh savings (and the improvement in efficiency is shown as a negative number). The higher the new heat pump's cooling efficiency, the lower the amount subtracted from savings
2) Proposed ratings must be based on ARI 210/240 (for under 135,000 Btuh capacity) or ARI 340/360 (135,000 Btuh and above).
3) For capacities 65,000 Btuh and greater, the COP rating is to be for outdoor air temperatures 47°F db and 43°F wb.
4) Equivalent full load hours are the hours per year the equipment is operating multiplied by the average load factor.
5) This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between the customer and Seattle City Light.

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for HYDRONIC HEAT PUMPS[1]

In Section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors.*
Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.
Multiple identical heat pumps may be considered on a single sheet.

Facility Name | Form Completed by | Manufacturer & Model Number | Date

I. BASELINE AND PROPOSED EFFICIENCY RATINGS

*Fill out the row which corresponds to the type and cooling capacity of your heat pump unit(s), then continue with **Section II**.*	Check One	Baseline (City & State Energy Codes)		Proposed (from manufacturer's literature)[2]	
		Cooling	**Heating**	**Cooling**[3]	**Heating**[3]
Rated Cooling Capacity (Btu / hr)		col. a	col. b	col. c	col. d
less than 17,000		11.2 EER	4.2 COP	EER	COP
17,000 up to 134,999		12.0 EER	4.2 COP	EER	COP

II. ENERGY SAVINGS, PROJECT COSTS, ESTIMATED FUNDING

A	Cooling efficiency improvement	1 / col. a - 1 / col. c		Watt / Btuh	Cooling
B	Cooling capacity per heat pump	from manufacturer's literature		Btuh	
C	Cooling equivalent full load hours[4]	--------	900	hr / yr	
D	Cooling energy savings per heat pump	(line A x line B x line C) / 1,000		kWh / yr	
E	Heating efficiency improvement	.293 / col. b - .293 / col. d		Watt / Btuh	Htg
F	Heating equivalent full load hours[4]	--------	1000	Hr / yr	
G	Heating energy savings per heat pump	(line E x line B x line F) / 1,000		kWh / yr	
H	Total energy savings per heat pump	line D + line G		kWh / yr	Total
I	Number of identical hydronic heat pumps	use one sheet per type of heat pump			
J	Total cooling capacity	(line B x line I) / 12,000		Tons	
K	Total energy savings	line H x line I		kWh / yr	
L	Heat Pump Cost	Enter the material or the incremental cost.			Cost & Funding Caps
M	Type of Cost entered on row L	Material or Incremental cost (enter M or I)			
N	Cost Cap	50% of material cost, or 100% of incremental cost			
O	Value of Savings to SCL	line K x ($ 0.23 / kWh)			

Seattle City Light Use Only

Approved Funding Amount[5]	Approved by (initial):	Date:

Footnotes:

1) If the proposed heat pump is evaporatively cooled, or cooled by ground water, a separate, custom calculation is used by SCL. Those applications were left off this sheet to simplify the funding calculation form for the most common type of hydronic heat pump.
2) Proposed efficiencies must be rated based on ARI/ISO 13256-1.
3) The cooling EER is rated at a 86°F entering water temperature (EWT). The heating COP is rated at a 68°F EWT.
4) Equivalent full load hours are the hours per year the equipment is operating multiplied by the average load factor.
5) This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between Seattle City Light and the customer.

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for
Packaged Terminal Air Conditioners (PTAC) and Packaged Terminal Heat Pumps (PTHP)

Use this form for heat pump or air conditioner funding if the proposed equipment falls under the ARI definition of a Packaged Terminal Air Conditioner or Packaged Terminal Heat Pump.
In Section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors.*
Complete the shaded areas only. The non-shaded areas are calculated and filled in automatically.
Multiple identical units may be addressed on a single form.

Facility Name | Form Completed by | Manufacturer & Model Number | Date

I. BASELINE AND PROPOSED EFFICIENCY RATINGS

Fill out the row which corresponds to the type of equipment and type of project, then continue with Section II.	Baseline[1]					Proposed[2]			
	Cooling			Heating		Cooling rated at 82°F db		Heating	
Equipment and Project Types[3]	Proposed Rated Cooling Capacity in Btuh	Calculation input	EER	Calculation input	COP	From Manufacturer's Literature		From Manufacturer's Literature	
	col. a	col. b	col. c	col. d	col. e	col. f		col. g	
PTAC, new construction		14.7		na	na		EER	na	
PTAC, replacement		13.1		na	na		EER	na	
PTHP, new construction		14.5		3.2			EER		COP
PTHP, replacement		13.0		2.9			EER		COP

II. ENERGY SAVINGS, COST & FUNDING

A	Cooling efficiency improvement	1 / col c - 1 / col f		Watt / Btuh	Cooling
B	Cooling capacity	from manufacturer's literature		Btuh	
C	Cooling equivalent full load hours[4]	--------	700	hr / yr	
D	Cooling energy savings per unit	(line A x line B x line C) / 1,000		kWh / yr	
E	Heating efficiency improvement	0.293 / col e - 0.293 / col. g		Watt / Btuh	Htg
F	Heating equivalent full load hours[4]	--------	1,600	Hr / yr	
G	Heating energy savings per unit	(line E x line B x line F) / 1,000		kWh / yr	
H	Total energy savings per unit	line D + line G		kWh / yr	Total
I	Number of identical PTAC or PTHP	Use one sheet per type of PTAC.			
J	Total cooling capacity	(line B x line I) / 12,000		Tons	
K	Total energy savings	line H x line I		kWh / yr	
L	Cost	Enter the material cost or the incremental cost.			Cost & Funding Caps
M	Type of Cost entered on row L	Material or Incremental cost (enter M or I)			
N	Cost Cap	50% of material cost or 100% of incremental cost			
O	Value of Savings to SCL	line K x ($ 0.20 / kWh)			

Seattle City Light Use Only

Approved Funding Amount[5]	Approved by (initial):	Date:

Footnotes:

1) Baseline efficiencies are taken from the Seattle and State Energy Codes. **If the proposed heat pump is replacing resistance heat in an existing facility, SCL will create a Custom Incentive calculation.**
2) Proposed ratings must be based on ARI 310/380.
3) Use the "new construction" category for replacements unless the existing unit has sleeves < 16 " high and < 42 " wide.
4) Equivalent full load hours are the hours per year the equipment is operating multiplied by the average load factor.
5) This form is not a guarantee of Seattle City Light funding. Funding can only be guaranteed through a formal contract between Seattle City Light and the customer.

Seattle City Light / Energy Smart Services

FUNDING CALCULATION WORKSHEET for VARIABLE SPEED DRIVES serving HVAC VAV SYSTEMS

In Section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheets for HVAC and Motors.*

Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.

Facility Name | Form Completed by | Date

I. ELIGIBILITY

Use this form to calculate SCL funding for VSDs to replace inlet vane or discharge damper controls on supply and return fans serving HVAC variable air volume (VAV) air distribution systems in existing buildings.

II. ANNUAL ENERGY SAVINGS

Line	Manufacturer / Model Number	Application: Supply Fan or Return Fan (SF or RF)	Number of Motors	Rated Horsepower per Motor	Total Rated Horsepower	Hours per Year Motor is On	Annual Energy Savings (kWh/yr)
			col. a	col. b	col. c = a x b	col. d	col. e = c x d x 0.148
1							
2							
3							
4							
5							
6							
7							
8							
+Lines	Click button to add lines.						
A		**Total**					

III. COST & FUNDING

B	VSD Cost	Enter the total cost of the VSD.	
C	Type of Cost entered on row B	Enter T.	
D	Cost Cap	70% of total cost	
E	Value of Savings to SCL	(line A, col. e) x $ 0.23 / kWh	

Seattle City Light Use Only

Approved Funding Amount[1]	Approved By (initial):		Date:	

Footnotes

1) This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between Seattle City Light and the customer.
2) Column a. A single line may be filled out for multiple identical VSDs (same motor hp and same VSD model). In that case, enter the number of identical VSDs (and motors) here.

Seattle City Light / Energy Smart Services
FUNDING CALCULATION WORKSHEET for NEMA PREMIUM EFFICIENCY MOTORS

In section 2C of the Program Manual, see the *Instructions for Filling out the Funding Calculation Worksheet for HVAC and Motors.*

Complete the shaded areas only. The non-shaded areas are calculated and filled out automatically.

Facility Name _____ Form Completed by _____ Date _____

I. ELIGIBILITY

SCL funding is not available for motors controlled by VSDs.

II. ANNUAL ENERGY SAVINGS & FUNDING

Line	Manufacturer / Model Number	Location and Application	# of Motors	HP per Motor	Total Rated HP	Run Hours Per Year	Application Code C = Commercial I = Industrial	kW Reduction per Motor	Motor Funding Coefficient	Total kWh / Yr Savings	Value of Savings to SCL
			col. a	col. b	col. c = a x b	col. d	col. e	col. f	col. g	col. h = a x d x f	col. i = a x d x g
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
A	Click button to add lines	Total									

III. COST & FUNDING

B	Motor Cost	Enter the material or the incremental cost.	
C	Type of Cost entered on row B	Material or Incremental Cost (enter M or I)	
D	Cost Cap	50% of Material Cost, or 100% of Incremental Cost	
E	Value of Savings to SCL	(line A, col. i)	

Seattle City Light Use Only

Approved Funding Amount:	
Approved By (initial):	
Date:	

Instructions

General. This form is not a guarantee of funding from Seattle City Light. Funding can only be guaranteed through a formal contract between the customer and Seattle City Light.

Column a, Number of Motors. Multiple identical motors may be entered on a single line.

Column e, Application Code. Enter **C** for motors serving commercial loads such as HVAC fans and pumps. Enter **I** for motors used in industrial processes.

Columns f and g. The kW reduction and motor funding coefficients are automatically transferred from the *Motor Reference Table,* located on a tab near the end of this workbook.

Seattle City Light / Energy Smart Services

NEMA Premium Efficiency Motors

- Motor Reference Table -

The KW reduction and funding amounts in the Motor Funding Calculation Form are automatically taken from this table.

In order to be eligible for funding, the selected motor must have a rated full load nominal efficiency that is no less than the NEMA Premium Efficiency.

Motor Hp	NEMA Premium Efficiency[1]	Commercial Loads[2]		Industrial Loads[3]	
		Estimated kW Reduction	Motor Funding Coefficient	Estimated kW Reduction	Motor Funding Coefficient
1	85.5%	0.0222	$0.0052	0.0222	$0.0033
1.5	86.5%	0.0270	$0.0063	0.0270	$0.0040
2	86.5%	0.0359	$0.0084	0.0359	$0.0054
3	89.5%	0.0607	$0.0141	0.0607	$0.0091
5	89.5%	0.0667	$0.0155	0.0667	$0.0100
7.5	91.0%	0.1216	$0.0283	0.1216	$0.0182
10	91.7%	0.1400	$0.0326	0.1400	$0.0210
15	93.0%	0.1851	$0.0431	0.1851	$0.0278
20	93.0%	0.2468	$0.0575	0.2468	$0.0370
25	93.6%	0.2890	$0.0673	0.2890	$0.0433
30	94.1%	0.3063	$0.0714	0.3063	$0.0459
40	94.1%	0.2626	$0.0612	0.2626	$0.0394
50	94.5%	0.4456	$0.1038	0.4456	$0.0668
60	95.0%	0.4933	$0.1149	0.4933	$0.0740
75	95.0%	0.3943	$0.0919	0.3943	$0.0591
100	95.4%	0.7562	$0.1762	0.7562	$0.1134
125	95.4%	0.6516	$0.1518	0.6516	$0.0977
150	95.8%	0.6885	$0.1604	0.6885	$0.1033
200	95.8%	0.9181	$0.2139	0.9181	$0.1377

1) **According to the National Electric Manufacturers Association (NEMA), a motor must have a Full Load Nominal Efficiency rating no less than the one given here in order to classify as a "NEMA Premium Efficiency" motor. Make sure purchased motors meet this classification.**
2) For commercial loads, the baseline is the Seattle Energy Code (SEC, effective date 10/01)
3) For industrial process loads, the baseline for these calculations is EPACT (same as SEC at this time).

Standard Specifications for Chillers, Heat Pumps, Air Conditioners, and Motors

RELATED DOCUMENTS

Section 2–*Standard Specifications for All ECM Installation Incentives* applies to this project.

EQUIPMENT AND INSTALLATION

1. Chillers, Heat Pumps and Air Conditioners

Funded equipment must have a permanently affixed metal nameplate with the manufacturer, model number, and rated capacity either engraved or baked on at the factory. The nameplate must be located where it is readable once the equipment has been installed.

The rated efficiency of the installed equipment must meet or exceed the "proposed" efficiency given in the attached Seattle City Light *Funding Calculation Worksheets.* (Exception: If the rating given on the *Funding Calculation Worksheet* is in kW/ton, which is the inverse of an efficiency, the rating of the installed equipment shall be no greater than that given in the calculation form.) The rating conditions on which the efficiency ratings in the contract are based must also be used in determination of the efficiency rating for the installed equipment. For example, full load efficiencies cannot be substituted for weighted average, or seasonal efficiencies, and NPLVs cannot be substituted for IPLVs.

2. Chillers

Water-cooled chillers must be capable of operating reliably with condenser water supplied at temperatures down to 75°F. The cooling tower return water temperature setpoint (not to be confused with the cooling tower design condition) shall be no greater than 75°F.

Chiller controls shall provide proportional/integral (PI) control of the chilled water supply to avoid a drop in the chilled water supply temperature at low loads.

3. Air-to-air Heat Pumps

The control system must lock out back-up heat (including baseboards) at outside air temperatures above 50°F. If baseboards cannot be locked out, they must be removed completely. The control system shall minimize use of supplemental heat during start-up, morning warm-up, and defrost conditions. During normal operations, electric resistance heat is only to be used as the second stage of heating in the event the heat pump is unable to meet the load. Heat pump installations, like other HVAC projects, must meet the requirements of the Energy Code, including but not limited to requirements for a 5F deadband between heating and cooling setpoints, economizer requirements, and night setback requirements. All air-to-air heat pump installations shall include new thermostats fully compatible with the heat pumps they control.

4. Motors

Each motor shall have a Nominal Full Load Efficiency rating that is NEMA Premium or greater.

Motors shall have a permanently attached, factory mounted, metal engraved nameplate that clearly gives the following information:

- Manufacturer
- Model number
- Rated nominal full load efficiency
- Rated horsepower

No funding is available for motors driven by a VSD.

If the new motor horsepower is 100 Hp or more, and the motor is not being upsized or downsized, the rated operating speed of the new motor must be the same as the rated operating speed of the existing motor. If the rated operating speed of the existing motor is unknown, or cannot be found in a new Premium Efficiency motor, the speed of the driven equipment shall be measured before the motor is replaced, and the sheaves shall be replaced or adjusted (for variable pitch sheaves) until the speed of the driven equipment after the installation of the new motor is the same as before. Running equipment at a higher speed, particularly on constant speed pumps and fans, will generally reduce or even negate the savings gained from use of a higher efficiency motor.

The inrush current for high efficiency motors is sometimes greater than for a comparable lower-efficiency motor. The contractor shall either propose a motor that doesn't have an increased inrush current, or shall replace any parts of the electrical service to the motor that need greater capacity to handle the higher inrush current.

SUBMITTALS

Invoices shall be itemized with quantities, manufacturers, and model numbers.

Standard Specifications for Variable Speed Drives and Inverter Duty Motors

1. Related Documents

Section 2–*Standard Specifications for All ECM Installation Incentives* apply to this project.

2. General

This specification is intended primarily for variable speed drive (VSD) installations for variable air volume (VAV) fan systems but could be used for blowers, cooling towers and pumps if appropriately applied.

All VSD components and installations will meet or exceed all applicable State and local codes, and standards to include: ANSI, NEMA, NEC, NFPA and Factory Mutual.

3. Equipment

The VSD shall be of a large enough capacity to operate the motor at 60 Hz.

If a new motor is being purchased to allow reliable operation under VSD control, that motor must have an Inverter Duty rating. It must also be sized large enough to operate the driven equipment at full capacity.

For applications where the driven equipment was previously staged on and off in response to variations in load, the installed equipment shall have the capability of automatically staging on and off the equipment in addition to the automatic variation in speed.

The VSD shall convert 60 Hz utility power to adjustable frequency and voltage output power, providing adjustable motor speed from 10% to 115% of nameplate motor speed. If a pulse width modulated output is used, the VSD output carrier frequency shall be variable from 5 KHz to 15 KHz. The VSD shall not create a voltage rate of change greater than 1000 volts/microsecond or a peak voltage greater than 1000 volts to ground at the motor when connected to the VSD. The VSD shall include 3% input line reactors.

Power line noise shall not exceed the current distortion limits and line notch depths defined in IEEE Standard 519-1992, “IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems”.

In hospitals and other facilities when there is concern about RFI interference, the VSD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules and Regulations, Part 15 for Class A computing devices. For these facilities, pulse width modulation type drives shall include RFI filters and carry an FCC compliance label.

The VSD will have a digital meter to indicate percent of motor’s speed in Hz and motor’s load in Amperes.

The VSD shall be capable of operating any standard NEMA rated, "off the shelf" squirrel cage induction motor of 50% to 100% of the VSD capacity. It must be possible to substitute a new, rewound or smaller motor without replacing or making hardware modifications to the VSD.

The VSD will be equipped with at least two pass-through frequency bands to avoid unstable frequencies. The VSD will be able to operate with ± 10% fluctuation in the line voltage; ± 2% fluctuation in the frequency; and ± 5% phase imbalance.

The VSD will also be able to operate from 0°C to 40°C and up to 90% relative humidity.

Total VSD voltage distortion shall not exceed 5% and total displacement power factor will not be less than 94% at all speed levels. VSD efficiency must be at least 95%.

The VSD shall be designed to be able to continually operate at 110% of nameplate load of the motor to which the VSD is applied and sustain a 115% overload for 15 seconds. The VSD full load amperage rating shall meet or exceed NEC Table 430-150. The VSD shall provide the motor with electronic overload protection in compliance with NEC Article 430-2.

The VSD shall have separate acceleration and deceleration rates providing 0 to 100% motor speed modulation in a period of time adjustable from 3 to 60 seconds. The VSD shall have low frequency/low voltage start with linear adjustable ramp-up.

The VSD shall be mounted in a NEMA rated enclosure, suitable for the designed location. It is assumed that for each motor to be speed controlled, it will have its own independent VSD, unless otherwise approved by Seattle City Light.

4. Installation

For applications where the driven equipment was previously staged on and off in response to variations in load, the controls shall continue to use automatic on-off controls as a means of staging the equipment in response to variations in load. Thus if the VSD has reduced the speed down to its minimum setting and the load continues to drop, the controls will automatically shut off the driven equipment as the next stage of control.

For VAV systems and variable flow hydronic systems, the static pressure sensor shall be mounted in a location that will provide a stable and reliable static reading, as far away from the fan discharge as possible. The sensor location must be approved by Seattle City Light. The fan static pressure shall not be higher than the static pressure prior to the VSD installation.

The owner must inform Seattle City Light of any existing duct or building pressurization problems on the premises or any other existing facility problem that may affect the proper operation of the VSD and the long-term energy savings calculated in the Seattle City Light contract.

Existing fan outlet dampers or inlet vanes shall be fixed in the open position or completely removed. Duct over-pressurization protection should be installed in case of VSD or sensor failure.

Wire length between the VSD and motor shall be less than 60 feet and the wire length between VSD and filtering devices shall be less than 2 feet.

5. Inspection

For VSD installations that exceed a total of 50 Hp, the VSD manufacturer shall provide start-up commissioning of the VSD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning agent shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel shall not be acceptable as commissioning agents.

The owner will demonstrate to Seattle City Light that the drive is fully operational and that it accelerates/decelerates smoothly for the full range expected in response to the drive input signal. Acceleration/deceleration rates shall be documented in writing.

For VAV installations, the owner will demonstrate that the VAV boxes are in proper working order and will repair any deficiencies, if found.

6. Submittals

The owner will provide installation submittals that include: a detailed written sequence of operation; control schematics; FLA rating; quantity and Hp rating of the VSD; description of the proposed drive speed input signal; and a written description of any output signals to the energy management control system (EMCS). VSD specifications must be submitted and approved by Seattle City Light.

As-built documents will be verified as being received by the owner and checked for accuracy. At a minimum, these documents will include (1) operation and maintenance manuals, (2) warranty description, (3) written controls sequence with schematics, and (4) a copy of the signed-off final building permit. All documentation will be reviewed and approved by Seattle City Light before the inspection is considered complete.

The drive manufacturer and controls contractor will provide at least one hour of customer operator training on operation and service diagnostics to the owner at the time of the equipment commissioning.

The owner shall show proof that the VSD's and associated equipment are warranted from the seller for a period of at least one year from the time of beneficial use. The warranty will include all labor and materials necessary to repair or replace defective equipment.

7. Equipment Recommendations (items recommended but not required by City Light)

The VSD should provide protection against the following:

- Normal transients, surges and spikes of 2.3 times the peak line voltage for 1.3 milliseconds.

- Phase-to-phase or phase-to-ground faults. The output should disconnect without blowing a fuse. The system should not rely upon an isolation transformer.
- Excessively high or low DC bus voltage or incoming voltage.
- Excessive or absent speed control signal.
- Excessively high peak current. Instantaneous over-current trip circuits shall continuously monitor peak currents and shall provide protection when a high limit setting is surpassed.
- Individual motor overload.
- Over-temperature within the VSD enclosure.
- The VSD shall have a limited number of automatic restarts per a specific time period, as determined by the operator.
- The VSD shall have torque limit override and regeneration protection during speed modulation.
- No conductors shall carry power to the enclosure door in excess of 3 amps, 130 VAC and 50 VDC. In general, the high power section shall be mounted behind the control and processing circuits. Heat sinks shall be back-mounted.
- The VSD shall have a door-mounted Hand/Off/Auto switch and manual speed control. In Hand, the VSD output frequency is adjusted by the manual speed control. In Auto, the VSD shall be started and stopped via a remote dry contact (switched port shall not exceed 24 volts at 1 amp) and the speed shall be in proportion to a 0 to 10 VDC or 4 to 20 ma control signal.
- The VSD shall have a display panel and keyboard for setup, display of existing conditions (output frequency, voltage, amperage and runtime) and self-contained diagnostics. These diagnostics shall include power ON indication, bus charge indication and specific cause of fault indication. All setup programming shall be maintained in non-volatile storage so that no reprogramming will be necessary upon start up following a complete 90-day power loss.
- The VSD shall have a summary alarm dry contact indicating any protective circuit shutdown or failure.
- Provide an across-the-line starter that bypasses the VSD. Provide a "Drive/Off/Line/Test" switch on the VSD or bypass panel door. In "Drive", the motor will be powered by the VSD. In "Off", the motor shall not run. In "Line", the motor shall be powered across the line and the VSD shall be disconnected from both the motor and line power. In "Test", the motor shall be powered across the line and the drive shall be attached to line power but not to the motor.
- The VSD will have manual speed control capability.

- Each piece of equipment and the motor shall be separately grounded. Each ground lead shall be braided, kept to a minimum length and bonded to a common earth ground.
- The VSD shall automatically reset due to under-voltage, over-voltage, phase loss, or over-temperature faults.
- Motor noise, as a result of the VSD, shall be limited to three dB over across-the-line operation, measured three feet from the motor's centerline.